

## CLAIMS

We claim:

- 5           1.     A static data flow analysis method comprising:  
              chasing a data flow instance through a data flow graph until a transition  
instruction is encountered;  
              resolving the transition instruction to a procedure pointed to by a call graph; and  
              chasing the data flow instance into a data flow graph of the procedure.
- 10           2.     The method of claim 1, further comprising:  
              encountering a pointer dereference operand while chasing through a data flow  
graph;  
              chasing backward to resolve where the pointer points; and  
15           3.     The method of claim 1 wherein the procedure transition instruction is a  
call instruction, and the data flow instance chase is a forward chase.
- 20           4.     The method of claim 1 wherein the procedure transition instruction is a  
first instruction of a procedure, and the data flow instance chase is a backward chase.
5.     The method of claim 1 wherein the data flow graphs contain pointers to  
25           an internal representation of a program.
6.     The method of claim 5 wherein the internal representation comprises a  
graph data structure.

7. The method of claim 1 wherein the call graph contains pointers to an internal representation of a program.

5 8. The method of claim 2 wherein the resolved pointer dereference is a global type, and chasing continues at plural instructions that reference the global as operands.

9. The method of claim 2 wherein the resolved pointer dereference is a field  
10 reference type, and chasing continues at plural instructions that reference the field reference as operands.

10. The method of claim 1, wherein a state machine directs data flow chase through alternating states comprising instruction change states and data transformation  
15 states.

11. The method of claim 1 wherein the data flow graph of the procedure is built after the transition is resolved to the procedure.

20 12. The method of claim 1 wherein the inputs to the method comprise binary code, and a start state comprises a data instance and an instruction address in the binary code.

25 13. A method comprising:  
receiving binary code and a start state;  
creating from binary code a procedures and instructions representation;  
creating a call graph comprising pointers to procedures in the procedures and instructions representation;

creating a data flow graph for a procedure containing the start state, the data flow graph comprising pointers to instructions in the procedures and instructions representation;

5 chasing a data instance of the start state through instructions in the data flow graph corresponding to states in a state machine; and

upon encountering a procedure transition instruction in the data flow graph, corresponding to a state in the state machine representing the call graph, transitioning the data instance chase to a data flow graph of a procedure identifiable in the call graph.

10 14. The method of claim 13 further comprising:

upon encountering a pointer dereference in an instruction in a data flow graph corresponding to a state in the state machine representing a pointer dereference table, performing a backward recursive search indicated in the pointer dereference table according to the addressing mode of the pointer dereference, and identifying a location  
15 in the backward recursive search.

15 15. The method of claim 14 wherein the location indicates a field reference definition, and the data instance chase resumes at an instruction indicated by a field reference list.

20

16. The method of claim 14 wherein the location indicates a global reference definition, and the data instance chase resumes at an instruction indicated by a global reference list.

25 17. A computer readable medium comprising instructions for performing the method of claim 13.

18. A computer readable medium having instructions for performing a method comprising:

chasing a data flow instance through a data flow graph until a transition instruction is encountered;

5 resolving the transition instruction to a procedure pointed to by a call graph; and chasing the data flow instance into a data flow graph of the procedure.

19. The computer readable medium of claim 18 further comprising:

10 encountering a pointer dereference operand while chasing through a data flow graph;

chasing backward to resolve where the pointer points; and

continuing chasing the data flow instance from the resolved pointer dereference operand.

15 20. The computer readable medium of claim 18 further comprising:

the procedure transition instruction is a call instruction, and the data flow instance chase is a forward chase.

21. A computer-based service comprising:

20 means for creating an internal representation of a program;

means for creating a data flow graph comprising pointers to instructions in the internal representation;

means for creating a call graph comprising pointers to procedures in the internal representation; and

25 means for creating a field reference list comprising pointers to field references in the internal representation.

22. The computer-based service of claim 21 wherein the internal representation is a list data structure.

5 23. The computer-based service of claim 21 wherein the internal representation is a tree data structure.

24. The computer-based service of claim 21 wherein the internal representation is a graph data structure.

10 25. The computer-based service of claim 21 wherein the data flow graph edges are bidirectional.

15 26. The computer-based service of claim 21 wherein the call graph edges are bidirectional.

27. A computer system including a processor and memory, the memory comprising:  
a component for receiving binary files and creating internal representations;  
a component for accessing internal representations and creating a call data  
20 structure;  
a component for accessing internal representations and creating a data flow data structure, and  
a component for accessing internal representations and creating a global reference data structure.

25 28. The computer system of claim 27 wherein the memory further comprises a component for accessing internal representations and creating a field reference data structure.

29. The computer system of claim 27 wherein the call data structure and the data flow data structures are graph data structures.

5           30. The computer system of claim 28 wherein the global reference data structure and the field reference data structure are list data structures.